Analysing. Testing. Qualifying.

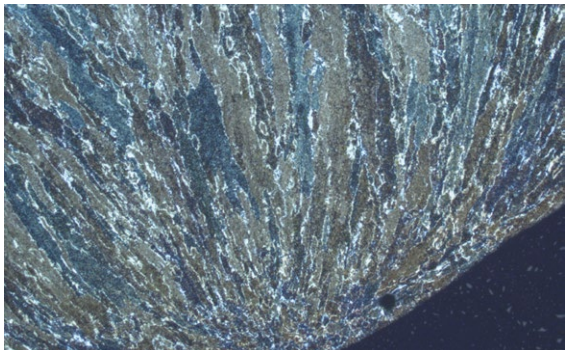
Qualification of rail vehicles and components

IABG

Key services for the rail vehicle industry

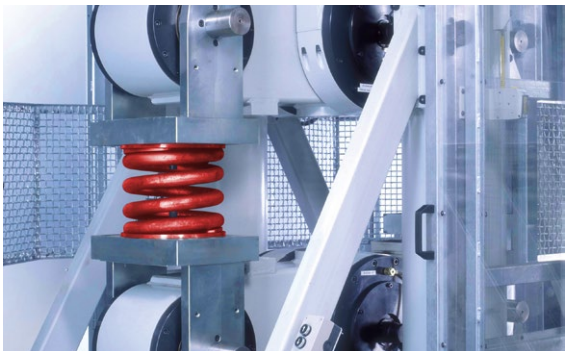
Fatigue strength

Environmental simulation

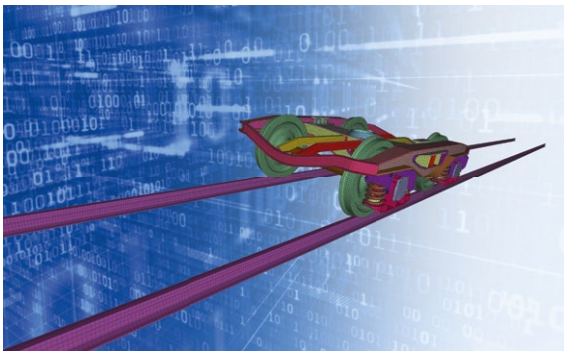


Failure analysis

Impact testing



Test benches



Simulation & Digital Twin

EISENBAHN-CERT EBC NOTIFIED BODY INTEROPERABILITY

DIE BAHNINDUSTRIE.
VDB VERBAND DER BAHNINDUSTRIE IN DEUTSCHLAND E.V.

ilac-MRA DAkkS Deutsche Akkreditierungsstelle D-PL-12001-02-00

Accredited by DAkkS in accordance with DIN ISO/IEC 17025:2018. Accreditation is only valid for the scope of accreditation listed in the document facility D-PL-12001-02-00.

Qualification of rail vehicles and components

IABG has been active in the field of securing technology solutions for around 60 years. As a manufacturer-independent service provider in the development process, we provide support in the areas of approval, operational monitoring, and failure analysis.

We see our role as a development partner of the rail industry. Our focus here is on the testing of components, the construction and operation of customer-specific test benches as well as development and analysis services. For component and structural tests we provide test infrastructure at our locations. This enables us to carry out tests on fatigue strength, environmental simulation such as temperature, climate, dust, corrosion, and stone impact. Our material laboratory completes our range of services with any necessary damage investigations. Results from the operation are transferred with us into higher availability and optimum utilization of the rolling stock.

The respective manufacturer and railway standards are applied in our test centres. In agreement with EISENBAHNCERT, IABG is authorised to carry out tests in accordance with Directive 2008/57/EC and its technical specifications for Interoperability and to call itself an *approved subcontractor of EISENBAHN-CERT*.

At the Dresden location we operate test benches for testing bogie frames and car bodies, at the Ottobrunn location we carry out failure analysis with the most modern testing equipment. We look forward to working with you to ensure your technology solutions.

Your IABG.

Fatigue strength
Car bodies

Fields of application

- Tests of head, middle, double-decker cars, tram modules or locomotive mainframes
- Investigation of car body structures against the background of new manufacturing technologies and lightweight design
- Validation of designs in vehicle development

Services

- Static test of car bodies according to DIN EN 12663, alternatively also according to other regional standards
- Implementation of static and dynamic tests with standardised load specifications or customer-specific requirements
- Creation of load assumptions and load spectra
- Online display of bending lines with predictions for direct comparison with the FE model and customer presentation
- Optical absolute displacement measurement for pre-bent car body structures
- Measurement of strains and deformations
- Testing under consideration of environmental conditions
- Modal analysis

Technical data • Capacity

- 5,000 m² variable testing area
- 2 car body test benches in parallel operation
- Each with up to 30 hydraulic cylinders
- Each with up to 500 measuring channels if required
- Longitudinal compression forces up to 5,000 kN to cover US standards
- Car bodies and/or coupled tram modules with a length of up to 32 m

Fatigue strength
Bogies

Fields of application

- Approval testing of all types of bogies (EMU, DMU, locomotives, trams, freight and passenger coaches, special vehicles) according to DIN EN 13749, VDV152, UIC regulations, and other standards
- Tests according to customer requirements in order to safeguard the function and strength of projects and new types of bogie constructions already in the development phase
- Gaining knowledge for production optimisation and the choice of production methods

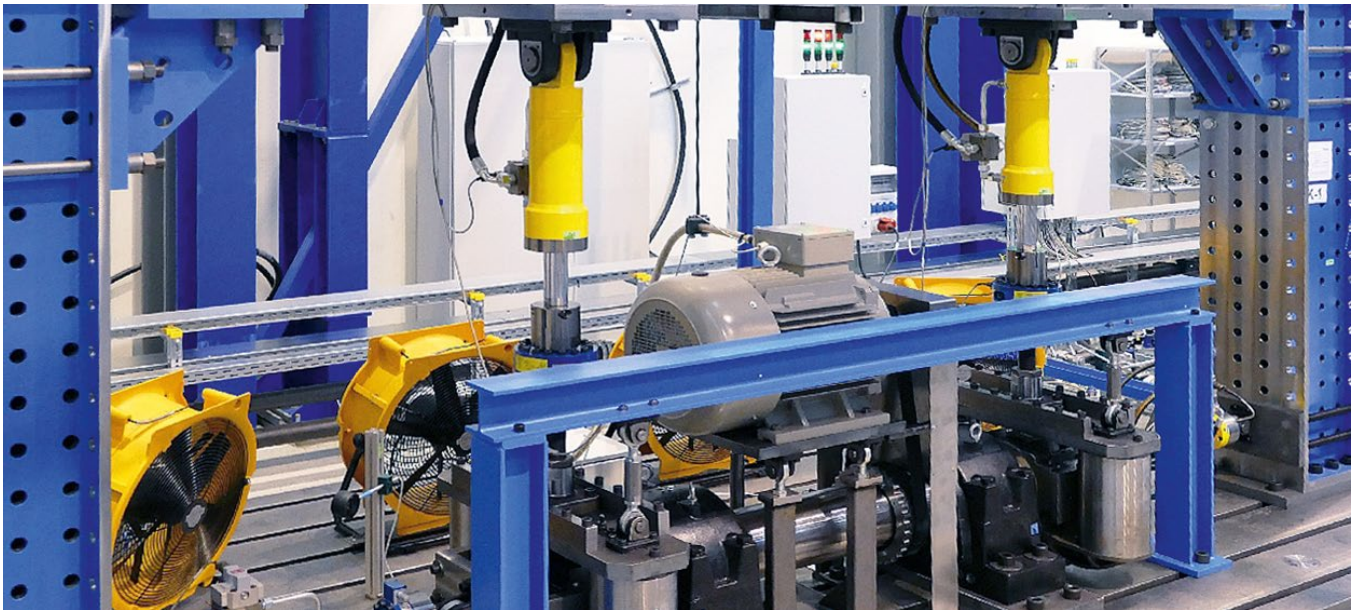
Services

- Static and dynamic tests with individual load components
- Test of two- and multi-axle frames
- Permanent damage monitoring
- Optical measurement of the geometrical dimensions of the bogie frame before, during and after the test in coordination with the customer
- Measurement of strains and deformations
- Non-destructive testing, failure analysis, test programme development and on-track measurements are offered as additional services

Technical data • Capacity

- 5,000 m² variable testing area
- Static and fatigue tests on 12 bogie frame test benches (4 high-perfomance bogie test benches, 8 bogie test benches) equipped with 30 hydraulic cylinders for parallel operation
- Use of state-of-the-art measurement and control technology as well as iteration software to increase test frequencies
- Two and multi-axis frames with calculated control channels
- Bogie frame with passive and active tilting technology
- Simulation of internal pressure

Fatigue strength
Parts & Components



Fields of application

- Performance tests on wheelset bearings according to DIN EN 12082
- Proof and function tests of components such as brake components, springs and dampers, rubber-metalelements, axle box housings, supports, consoles, couplers, wheel-swingarms, anti-roll bars, bolsters and roof and floor panels
- Static strength tests on multi-material leight weight structures such as front masks and floor sections
- Service life tests taking into account typical vibration and oscillation influences

Services

- Development of test bench concepts for applying of the required test conditions/flexible test set-ups
- Strength asessment under consideration of static and fatigue loads
- Permanent damage monitoring
- Non-destructive testing
- Vibration and shock tests on high performance shakers
- Tests under high and low temperatures

Technical data • Capacity

- In total of 16 test benches for individual tests in parallel operation
- Each test bench is equipped with up to 10 control and 50 measuring channels
- 4 test benches for performance tests on wheelset bearings according to DIN EN 12082
- Test bench for water tightness test on wheelset bearings according to DIN EN 12082
- Use of state-of-the-art measurement and control technology as well as iteration software for increasing the test frequencies
- Service load simulation
- Stand alone clamping fields

Environmental simulation

Fields of application

- Strength and functional tests on parts and components under the influence of humidity, high and low temperatures, high and low pressure, salt, dust and sun
- Simulation of ageing by exposure to different temperature and climate cycles

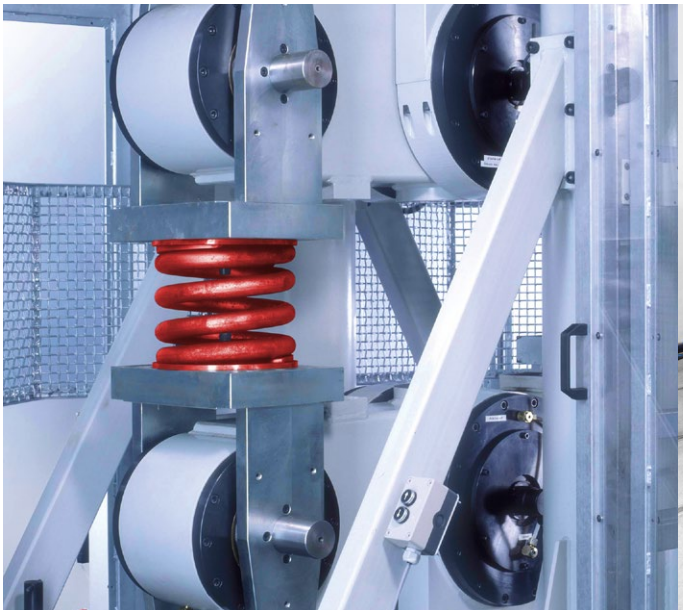
Services

- Environmental qualification accompanying development from the beginning of the design-phase to the finished product
- Reproducible testing under worldwide conditions
- Endurance tests, cold start and warm-up tests
- Climate testing of hydrogen-powered systems and high-voltage components

Technical data • Capacity

- Test facilities from 0.1 m³ to 180 m³ for climatic environmental simulation
- 6 large climatic chambers with temperature range from -70 °C to 150 °C and air humidity 10 % - 95 %
- Temperature shock devices
- Vacuum chambers
- Solar simulation system
- Powder and dust testing/simulation

Test benches



Fields of application

- Development and realisation of test systems for validation of new systems, functions and materials
- Complex test systems from a single source (general contractor with an efficient partner network)
- Specialist planning for test centres
- Support for customer development regarding new quality assurance procedures
- Definition and validation of test procedures
- Test automation and integration in the customer's tool and process landscape

Services

- Analysis and evaluation of test requirements
- Derivation and development of test procedures in accordance with requirements
- Specialist planning for test centres
- Development and realisation of turnkey test systems including requirement and project management
- Feasibility studies
- Concept development
- Construction
- Software development and automation
- Manufacturing and integration including supplier management
- Commissioning
- Education & Training
- Modernisation of existing test plants

Brief description

- We design, develop and implement complex test systems. Our range of services includes both standardised and customised test systems. The main areas of application are in the field of fatigue strength assessment and functional validation of mechatronic systems. We offer our customers solutions from one source. Depending on the specific solution, we combine our own services with those of external partners.
- We inspire our customers with demand-based, individual solutions, a high degree of automation and flexible integration into existing processes and infrastructure.

Impact testing

Fields of application

- Trains are exposed to high mechanical stresses such as hail, stone impact or vandalism.
- These influences can lead to massive damage to materials and components of the train.
- Impact tests with standardised projectiles reveal structural weak points of components such as e. g. windscreens, train fronts, side doors.
- Impact tests offer the possibility structural problems of components in advance and provide valuable insights for product optimisation.

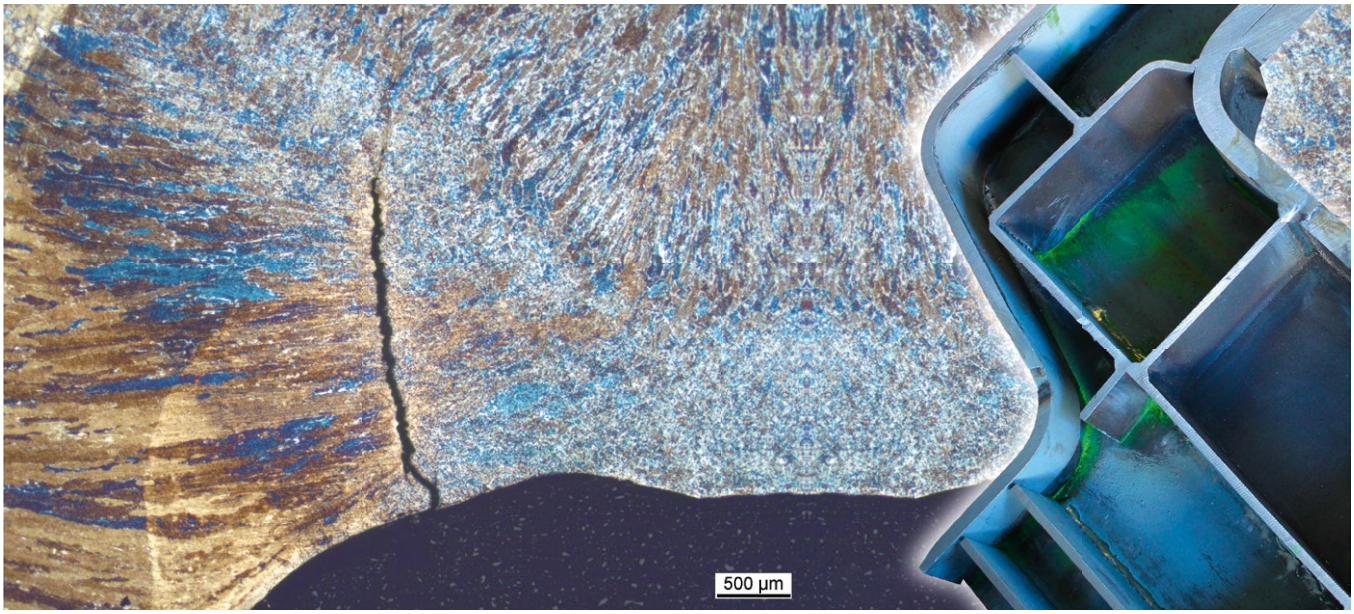
Services

- Impact tests according to international standards, e. g. IC 651, DIN EN 15152 and DIN EN 5566, NF F 15-818, GM/RT 2100 Appendix B or customer-specific specifications
- Investigation of failure mode by different types of test projectiles (metal projectiles, stone, gelatine, ice, etc.)
- Evaluation of deformation and strain
- Data acquisition with e. g. strain gauges, accelerometers, load cells
- Non-destructive testing methods, e. g. ultrasonic and eddy current, CT

Technical data • Capacity

- Realisable speeds of over 350 m/s
- Mass over 10 kg (depending on speed)
- Calibre up to 350 mm
- Almost any projectile geometry (symmetrical / asymmetrical)
- Specific adjustment of the flight attitude of the projectile
- High-speed acquisition of relevant parameters including digital image correlation
- Data acquisition with a sampling rate up to 1 MHz
- 172 hectare fenced area with excellent protection and security measures – both in the conduct of experiments and in secrecy

Failure analysis



Fields of application

- Investigation of damages, for example due to unsuitable materials, material quality, overload or wear
- Material investigations for the raw-material qualification of metals, non-metals, plastics up to fibre composites and material combinations
- Assessment of strength and reliability of various manufacturing and production processes including 3D printing

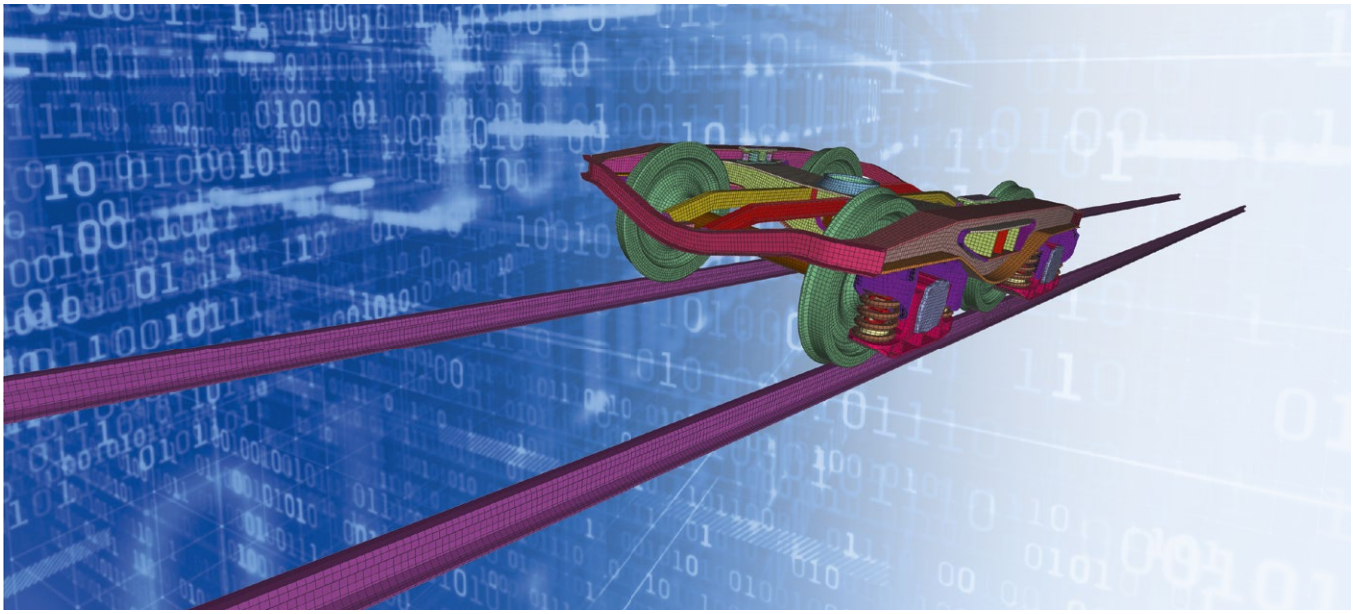
Services

- Systematic failure analysis according to VDI guideline 3822:
  - Determination of the primary damage mechanism
  - Derivation of causal influences
  - Remedial action and prevention of damage
- Macroscopy and stereoscopy
- Metallography/Materialography
- Scanning Electron Microscopy (SEM) – Chemical and physical material analyses
- Non-destructive testing methods:
  - Ambulatory metallography
  - Fluorescent dye penetration test (PT)
  - Fluorescent magnetic particle inspection (MT)
  - Computer tomographic component examination 2D/CT

Technical data • Capacity

- X-ray inspection centre (micromex, v|tome|x m, nanotome m)
- Macro thermogravimetry LECO TGA 701
- Hardness testers
- Scanning Electron Microscopes
- Light microscopy
- Digital microscope
- Residual stress measuring device

Simulation & Digital Twin



Fields of application

- Requirements management
- Product design and optimisation
- Computational qualification
- Integrity management
- Digitalisation

Services

- Development of design and qualification concepts
- Virtual load data determination based on multi-body simulation and the use of AI
- Computational fatigue analyses
- Load data analyses and generation of damage-equivalent test signals (test time reduction, random vibration testing...)
- Computational fluid dynamics
- Structural health monitoring using model- and data-based approaches (Digital Twin & AI) incl. dashboards

Tools used

- CAD: Catia V5, SolidWorks, Creo
- FEM modelling: Hyperworks/Hypermesh, ANSA, Medina
- FEM-Solver: Abaqus, Nastran, ANSYS, Optistruct, LS-Dyna
- Foot and mouth disease solver: Adams, RecurDyn
- CFD: OpenFoam
- Strength assessment: nCode, FEMFAT
- Programming languages: Fortran, Java, C++, LabView, Unity 3D
- Script languages: Python, Matlab/Simulink

IABG. The Future.

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Further information for
Qualification of rail vehicles and components

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